Denver Department of Public Health and Environment
Environmental Protection Division

The Denver Urban Air Toxics Assessment: Methodology and Results

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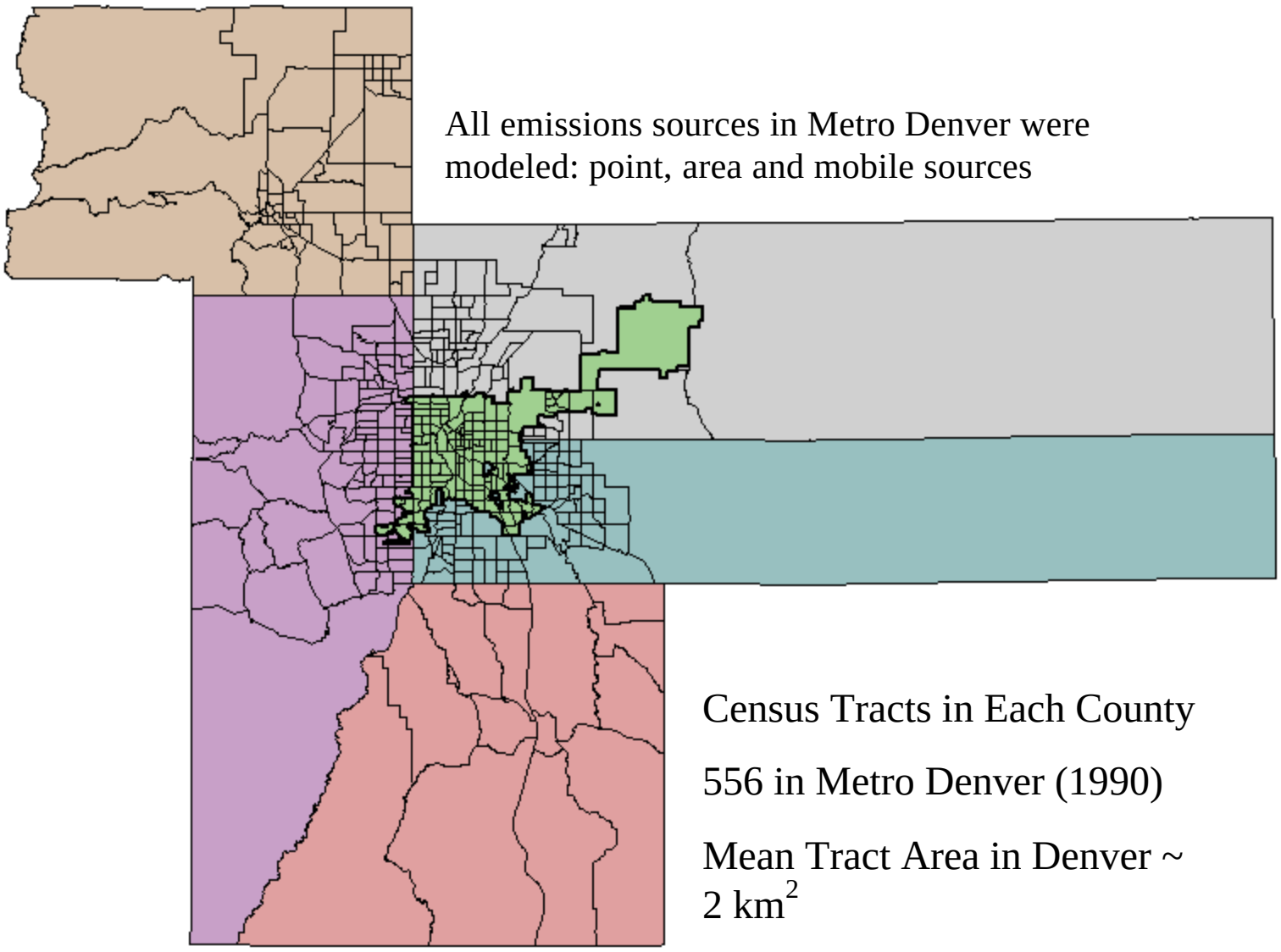
Why Is Denver Modeling Hazardous Air Pollutants (HAPs)?

- Amendments to the zoning provisions of the Denver Revised Municipal Code established the basis for agency reviews of zoning permits for new or expanding industrial facilities and include:
  - Air pollution caused by a stationary source
  - An evaluation of undue concentration of uses that create environmental problems and external effects
- In order to determine potential incremental impacts, need to establish baseline concentrations

Information Needed to Conduct the Assessment

- Geographic Information System (GIS) Themes and Data
  - Census themes, streets data, elevation/terrain data
- Emission Inventory
  - Point sources, mobile sources, area-wide sources
  - Combination of federal, state, local, and research data
- Method to Spatially and Temporally Allocate County-wide Emissions
  - Emissions vary throughout each county
- Run Processed Emissions Through an Air Dispersion Model (ISC3ST)
- Evaluate the Validity of the Model Using Monitored Data

Metro Denver Modeling Domain



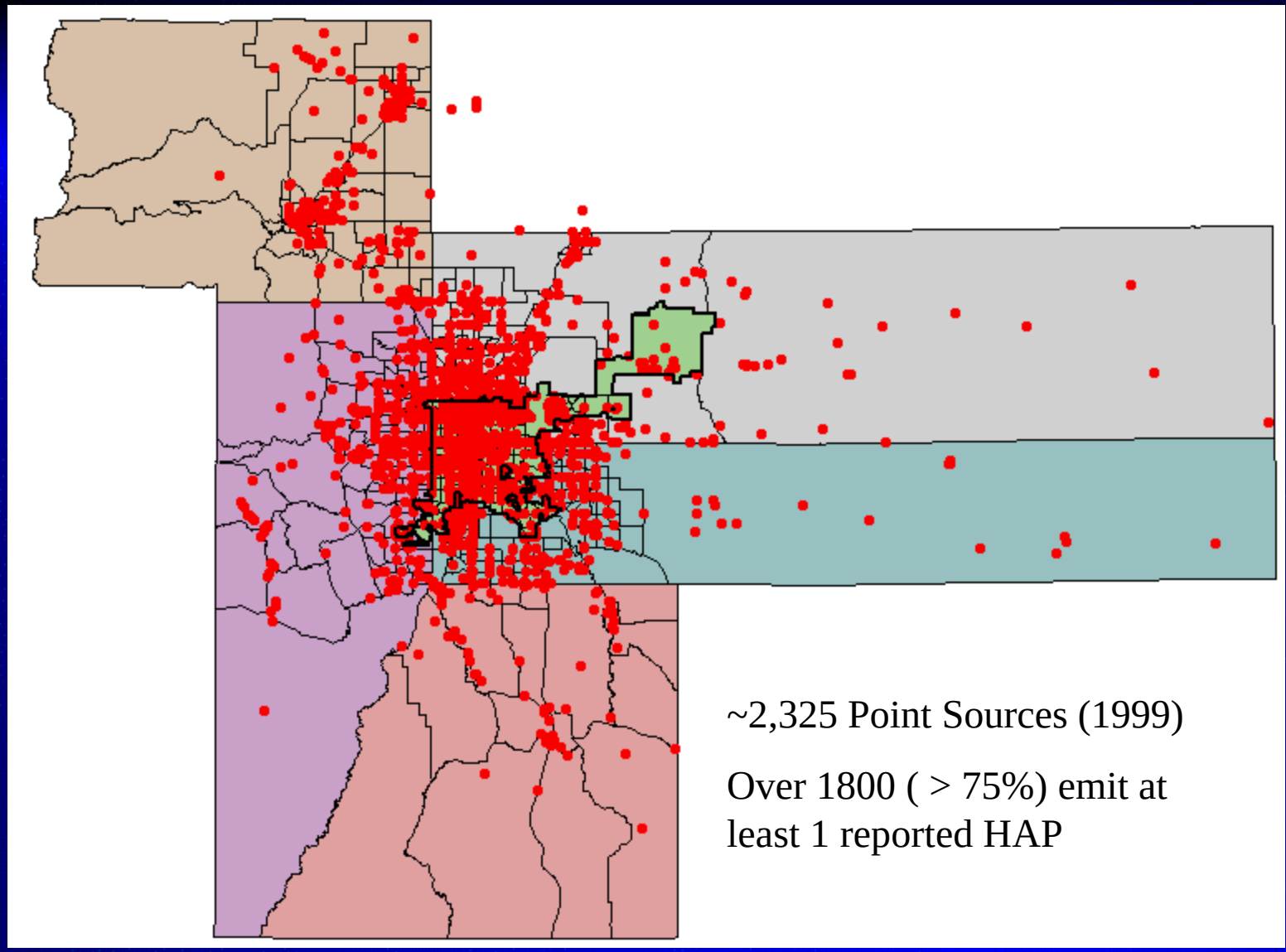
All emissions sources in Metro Denver were modeled: point, area and mobile sources

Census Tracts in Each County

556 in Metro Denver (1990)

Mean Tract Area in Denver ~ 2 km^2

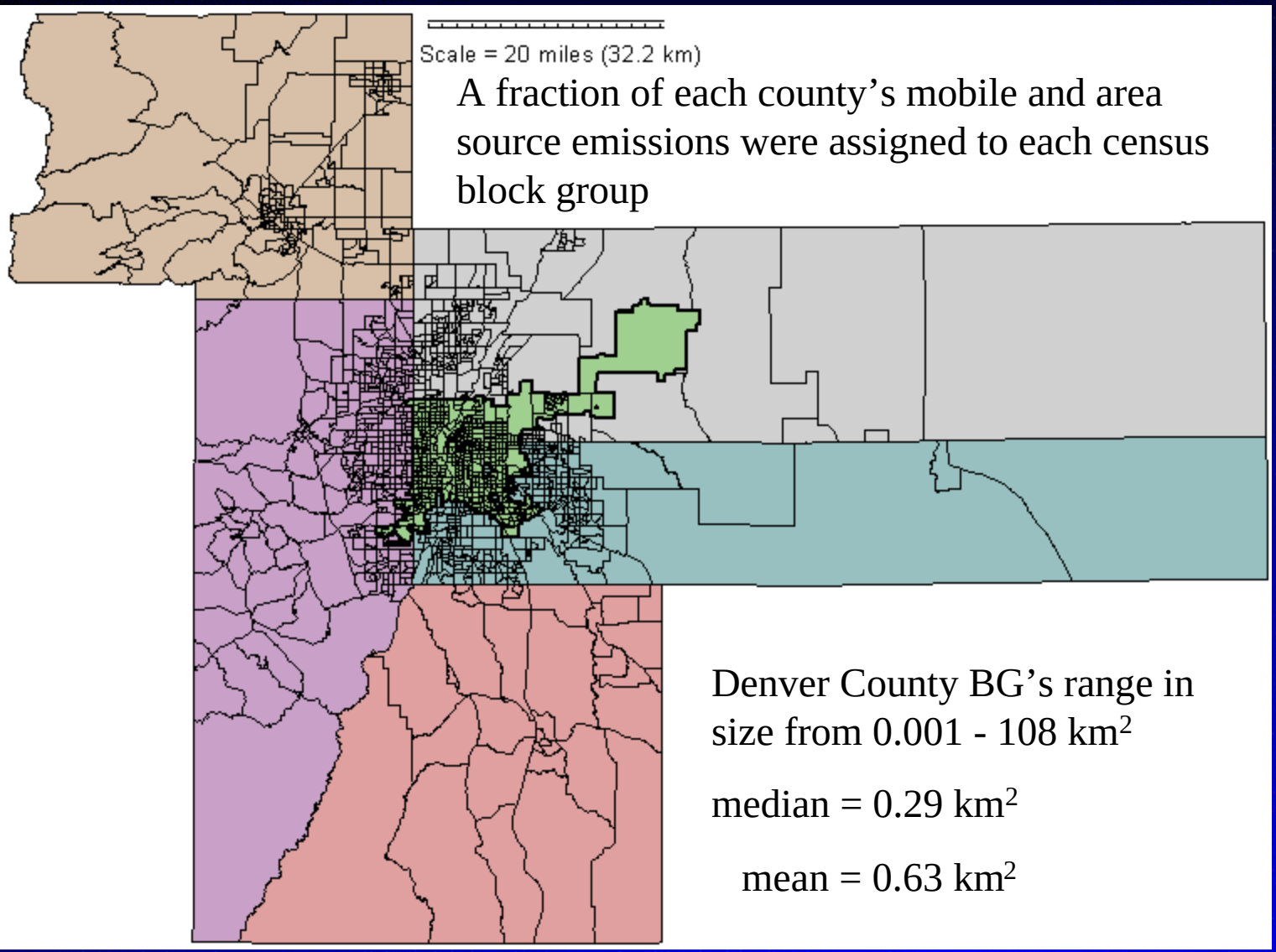
Point Source Locations



~2,325 Point Sources (1999)

Over 1800 (> 75%) emit at least 1 reported HAP

Metro Denver Census Block Groups



A fraction of each county's mobile and area source emissions were assigned to each census block group

Denver County BG's range in size from 0.001 - 108 km^2

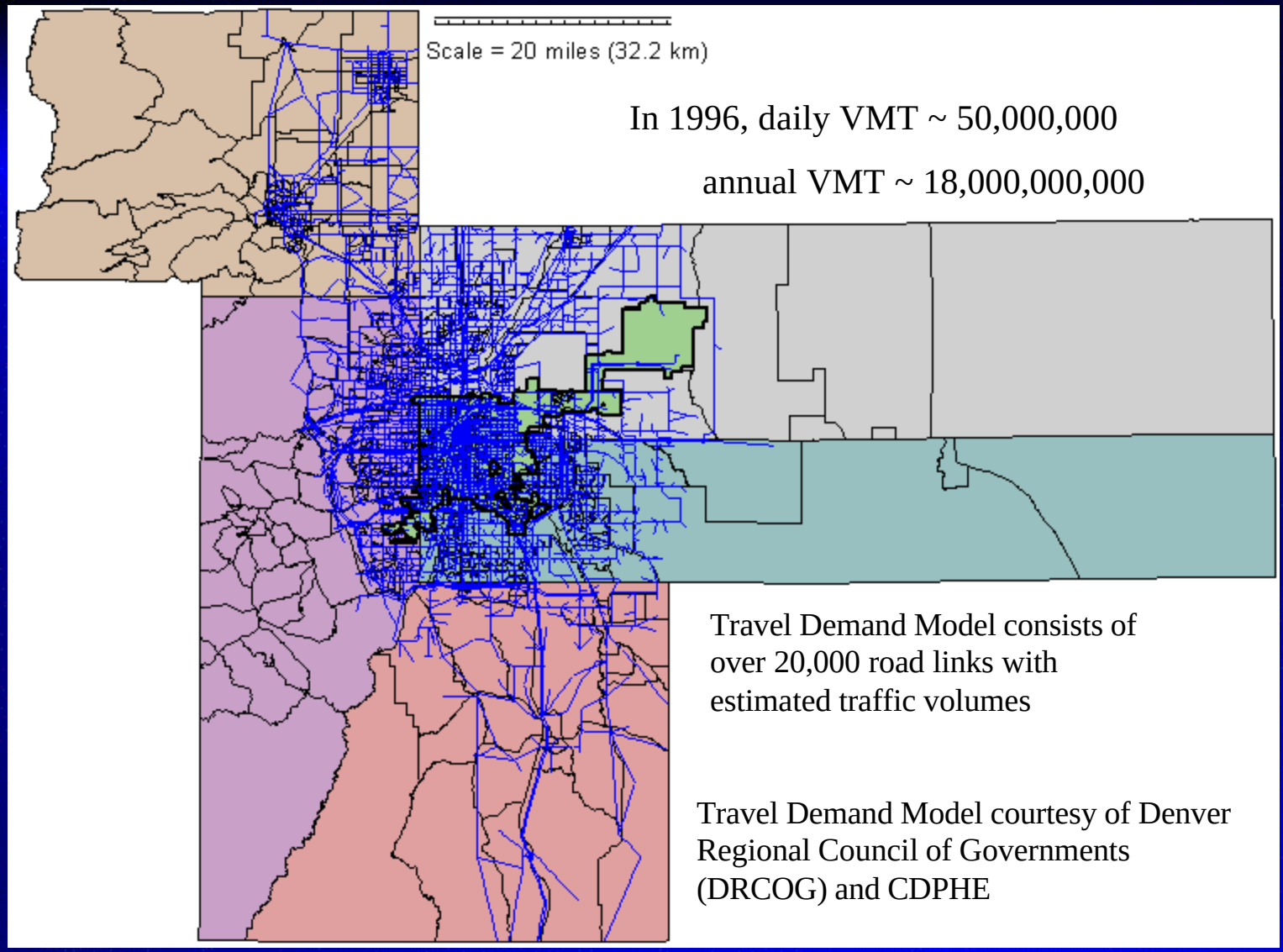
median = 0.29 km^2

mean = 0.63 km^2

Methods Used to Allocate County-Wide Emissions to Census Block Groups

- Area Sources
  - Emissions from consumer products, architectural surface coatings, wood burning, etc.
  - Surrogates: population, population density, inverse population density
- Mobile Sources
- On-road
  - Initial phase used roadway miles (or road density) in each census tract
  - Later phases used actual vehicle miles traveled (VMT) on each road link
- Off-road
  - Combination of area and mobile source surrogates listed above

Calculating VMT Surrogate for Mobile Emissions



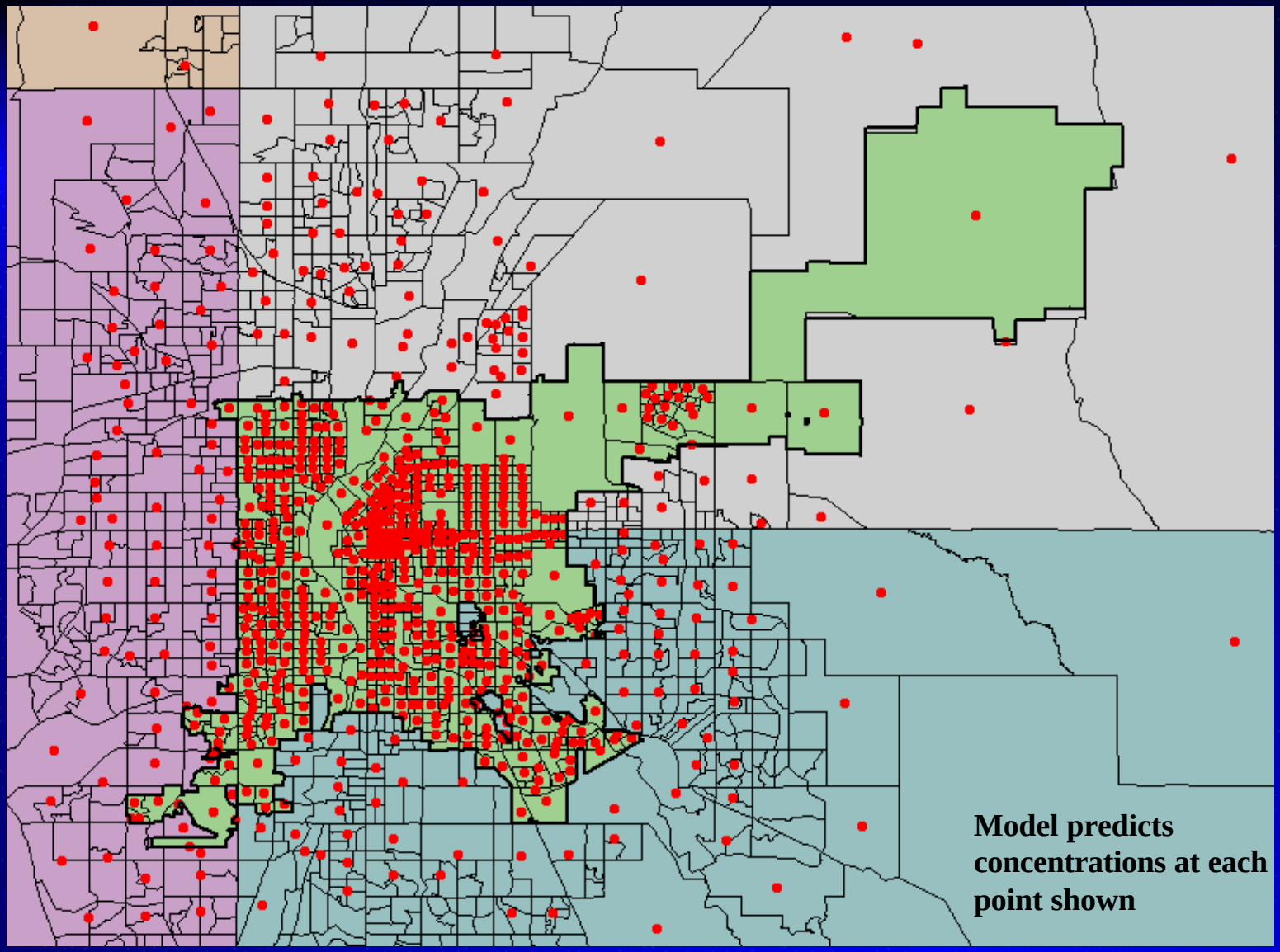
In 1996, daily VMT ~ 50,000,000

annual VMT ~ 18,000,000,000

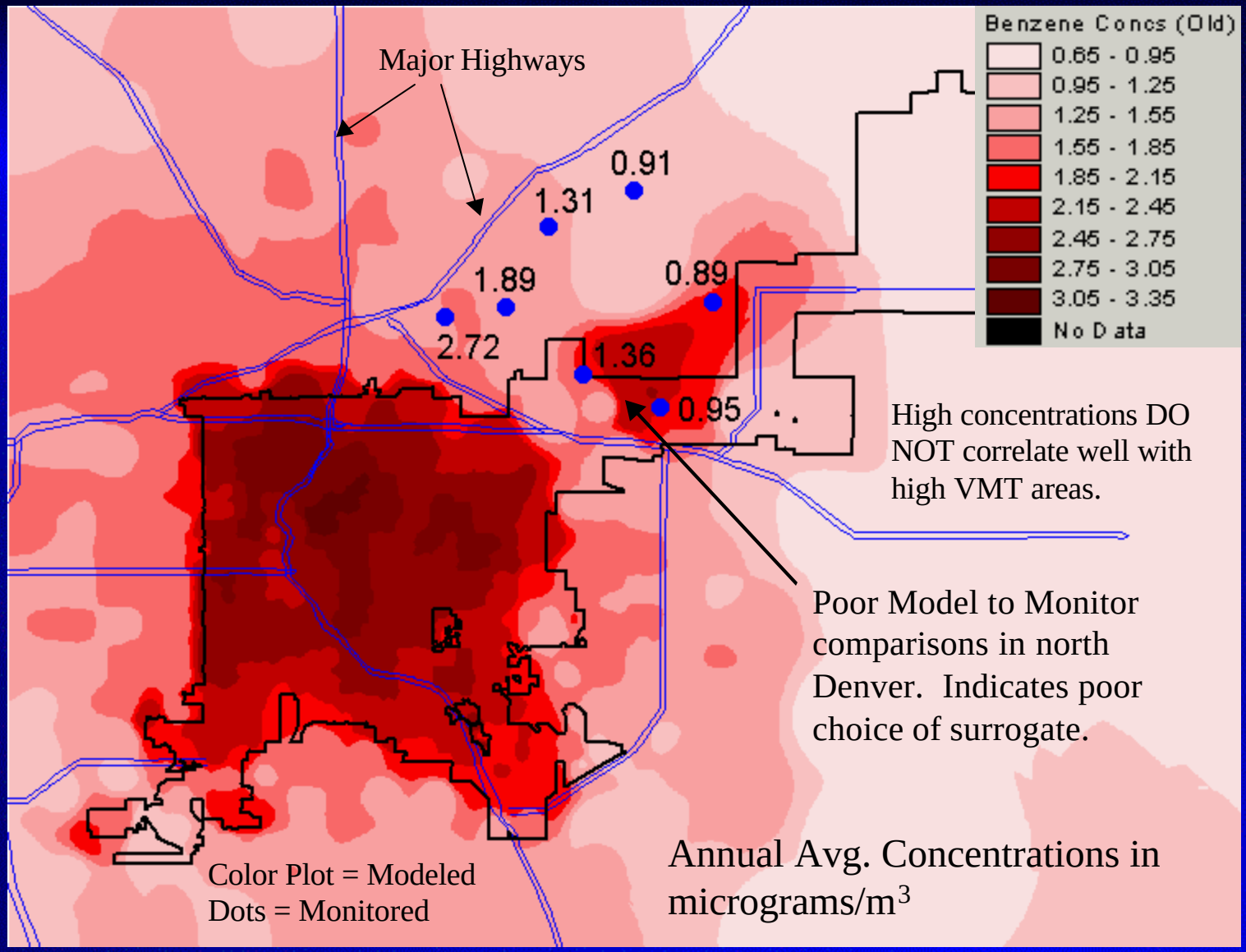
Travel Demand Model consists of over 20,000 road links with estimated traffic volumes

Travel Demand Model courtesy of Denver Regional Council of Governments (DRCOG) and CDPHE

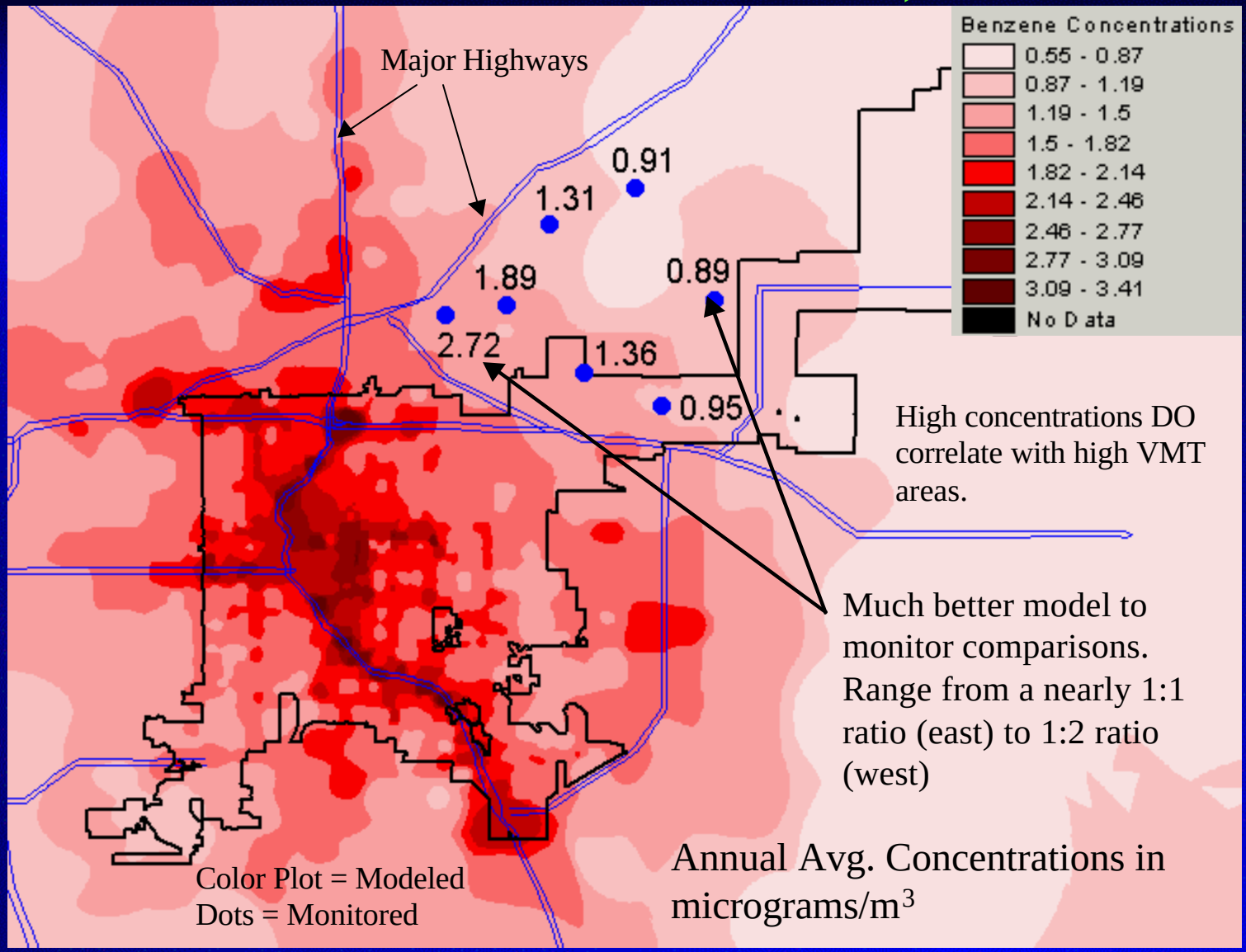
Dispersion Model Receptors



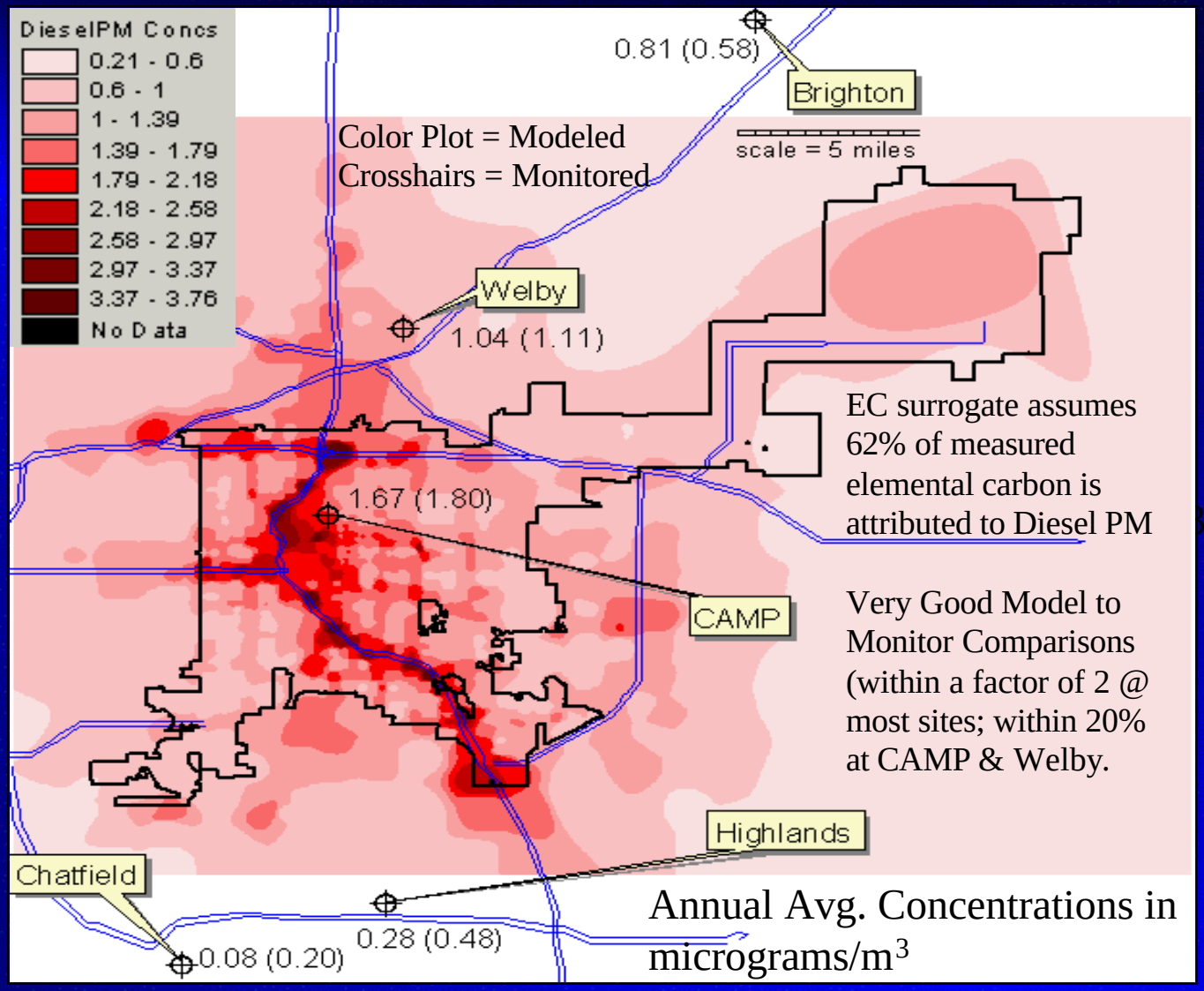
Predicted vs Observed Benzene Concentrations (Initial Phase of the Assessment)



Predicted vs Observed Benzene Concentrations (Current Phase of the Assessment)



Modeled Diesel PM concentrations with Estimated Actual Diesel PM Concentrations Determined from Chemical Mass Balance model and a Measured Elemental Carbon surrogate ( )



Lessons Learned To Date

- Accurate Emission Inventories area a MUST !
  - In most urban areas, mobile source emissions contribute significantly to ambient concentrations of air toxics
  - Denver has worked with Colorado Dept. of Public Health and Environment (CDPHE) to identify some major discrepancies in mobile, area and point source databases.
    - An ongoing process…...
- Monitoring Data Helps to Validate Methodology, Model Predictions and Emission Inventories

Summary

- Completed modeling for 74 air toxics
- Model-to-monitor comparisons are good for benzene and diesel particulate matter
- Benzene, Formaldehyde, Acetaldehyde, and Diesel PM appear to contribute most to inhalation risk estimates in Denver
  - Aldehydes are complicated due to secondary formation in the atmosphere
  - ISC3 can't model chemical transformation

Next Steps

- Model emissions for new or expanding facilities with the established baseline to determine if an unacceptable risk results
- Identify potential pollution prevention strategies that could allow the facility, in cooperation with other sources, to reduce the risk
- Foster communication with community groups upon revisions to the inventory and assessment